

I

A PRACTICAL EXPERIMENT IN  
SIMPLIFIED KEYBOARD RETRAINING

A Report of the Retraining of Fourteen Standard Key-  
board Typists on the Simplified Keyboard  
July, 1944

and

II

A COMPARISON OF TYPIST IMPROVEMENT FROM  
TRAINING ON THE STANDARD KEYBOARD  
AND RETRAINING ON THE SIMPLIFIED  
KEYBOARD

A Supplement to "A Practical Experiment in  
Simplified Keyboard Retraining"  
18 October 1944

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Washington, D. C.

JAN 3 1946

No Objections to Publication  
For Naval Security Reasons  
OFFICE OF PUBLIC INFORMATION, U. S. NAVY  
Security Review Section

## FOREWORD

At the request of Lt. Rice (Management Engineer) the Training Branch of PS&M\* trained five girls from EXOS (Executive Office of the Secretary) on Simplified Keyboard typewriters. This class started December 1942 and continued for approximately one hundred hours. A second group of ten (S&A and EXOS) started training 1 March 1943. This group likewise continued for approximately one hundred hours. Due to the fact that Navy machines were not provided for the trainees in their offices and to other factors serving as obstacles, the first two groups were not truly fair tests.

A telephonic conversation between the office of the Management Engineers and the Training Branch resulted in the training of a third group of trainees from eight bureaus from 17 January 1944 to 11 March 1944. This group was carefully controlled and comprehensive results of their performances recorded. Former groups were not so controlled.

The accompanying material contains a complete report of the training of the third group and the results obtained as well as pertinent facts concerning the history of the typewriter and the development of the Simplified Keyboard.

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\* PS&M (Personnel Supervision and Management) was consolidated with Shore Establishments and at present is known as SECP (Shore Establishments and Civilian Personnel). As this report was completed following the consolidation, it is now being submitted from the Head of the Training Branch of SECP to the Management Engineer.



# I---- A PRACTICAL EXPERIMENT IN SIMPLIFIED KEYBOARD RETRAINING

In the last two decades an average of 750,000 students enrolled annually in typewriting classes in the United States. These should have provided a reserve of 8 to 10 million competent typists--easily adequate to fill our present need for 2 1/2 million typists. Competence according to U. S. Civil Service Commission standards prior to 1941, required in part; that a typist be able to type at 50 net words per minute for 10 to 15 minutes. Today typists who can do 30 n.w.p.m. are immediately classified as CAF-2 typists and, in Washington, D. C., are paid \$1752 per year. Individuals with less or no typing ability are employed in various civilian and government agencies and trained on the job.

The Navy Department as well as other government departments maintains recruitment staffs to canvass possible sources for stenographers, typists and clerical workers. What has become of the missing eight to ten million typists allegedly trained in our schools since 1924? A critical examination discloses that the eight to ten million competent typists never existed. Typist performances after one, two, and three years of typing instruction have been much lower than is customarily assumed.

Owens,<sup>1</sup> Kibby,<sup>2</sup> Kochka,<sup>3</sup> and Carmichael<sup>4</sup> separately surveyed student-typist accomplishment in different parts of the country. Their conclusions, based upon more than 100,000 student typists, agree that at the end of the first, second, and third years of typewriting courses:

	1st year	2nd year	3rd year
	NET WORDS PER MINUTE		
25% of the students type less than:	21.5	36	42
75% of the students type less than:	35	47	52
The rare typist reaches:	70	76	72
The average typist types at:	26.7	40.4	47
Total number hours of instruction was:	180	360	540
Over-all average typist gain in net words per minute per hour of instruction was:	.15 ( $\frac{26.7}{180}$ )	.11 ( $\frac{40.4}{360}$ )	.09 ( $\frac{47}{540}$ )
Ave. n.w.p.m. gain - 180 hours instruction - was:	26.7	13.7	6.6
Average n.w.p.m. gain per instruction hour was:	.15 ( $\frac{26.7}{180}$ )	.079 ( $\frac{13.7}{180}$ )	.036 ( $\frac{6.6}{180}$ )

Dr. Frederick G. Nichols of Harvard University aptly summarized the results of typewriting instruction with, "As at present taught, typewriting is about the most time-consuming subject in any educational program on any level.... Between two and three full years--often more--are needed for the rather low degree of mastery acquired in this subject. This is too much."<sup>5</sup> Equally aware of the need for improvement in typist performance, the Carnegie Foundation for the Advancement of Teaching in 1933 and 1934 assigned two grants to the University of Washington for a searching investigation of the causes and remedies for the low average typist performance.

- 1 Owens, C. B. "Standards in Typewriting" American Shorthand Teacher (1930) Vol. XI, pp. 89-98.
- 2 Kibby, Ira W., "A Study of Typewriting Accomplishments in California Secondary Schools," Mimeographed Report, State Department of Education, Sacramento, California, March, 1933.
- 3 Kochka, Joseph L., "Norms of Achievement in Speed and Accuracy in Typewriting," Balance Sheet, January, 1934, pp. 199-206.
- 4 Carmichael, V. H., "Objective Measurement of Accomplishment in Typewriting of High School Commercial Pupils in Indiana," Monographs in Education, No. 12, University of Iowa, Research Studies in Education, 1932.
- 5 Typewriting Behavior, American Book Company, 1936, (Page V).



The study (1933-41) explored the psychological, educational, and time and motion factors involved in learning to type and in typing. The investigation<sup>6</sup> disclosed that typist fatigue, low typist performance, typographical errors, and most of the difficulties students encounter in learning to type, are primarily due to the faulty arrangement of the Standard Keyboard.\* The study reports that the present Standard Keyboard was planned for "Hunt and Peck" typing with two fingers and was arranged to meet the mechanical limitations of typewriters in 1873. If letters are placed in rows by pure chance, keyboard arrangements can be secured that give equitable distribution of work to the two hands and the eight fingers, whereas, on the Standard Keyboard, the weaker left hand does 57% of the typing and two fingers do 23% each while six fingers do an average of 9 1/4% of the typing.

Briefly, the study concludes that typing is needlessly (1) difficult to master (as is evident), (2) conducive to typing errors (as most typists and employers will testify), (3) slow (evident from the data), (4) fatiguing (recognized by most typists), because the Standard Keyboard (a) overloads the left hand - 57% vs. 43% for the right, (b) overworks certain fingers (23% load for the left first finger vs. 1.3% load for the right fourth finger), (c) places frequently-used letters in poor positions, (d) requires excessive finger motions from row to row (total--12 to 20 miles per day for a good typist), (e) requires intricate finger motion patterns for typing common words, (f) requires 3800 different words to be typed by one hand while the other hand idles, and (g) permits few words (only 89) to be typed exclusively with the letters in the best positions--the home or guide row.

The Simplified Keyboard was scientifically arranged on the basis of the frequency of use of letters and the frequency of letter patterns and sequences in the English language. Consequently, it is claimed to be (1) easier to master, (2) more accurate, (3) faster, and (4) less fatiguing.

Various data are cited to show that the Simplified Keyboard is easier to master, faster and more accurate. For instance, on the Simplified Keyboard, seventh and eighth grade children in the University of Chicago Laboratory School<sup>7</sup> achieve better typing performances in 30 weeks than are being secured by High School and College students in a full school year on the Standard Keyboard. High school students after one year--or 180 hours--of instruction on the Simplified Keyboard reach an average of 48 net words per minute, whereas, the 3rd year average on the Standard Keyboard is only 47 n.w.p.m. On the Simplified Keyboard, a 15-year-old first-year high school girl made an International Commercial Schools Contest score of 94 net words per minute. In the same contests, a second-year high school score of 113 n.w.p.m. and a business college score of 128 n.w.p.m. were made on the Simplified Keyboard. In nine years (1933-42) Simplified Keyboard typists established 26 International Contest records in their respective divisions, and won 45 first awards, 27 second awards and 28 third awards--a total of 110 winning places.<sup>8</sup> Indisputably, it is obvious that the Simplified Keyboard is easier to master than the Standard Keyboard.

Prior to the war, manufacturers, without additional charge for the Simplified Keyboard, have supplied new Simplified Keyboard typewriters whenever they were ordered. Building Simplified Keyboard typewriters requires only changes in final assembly; no new machinery or new processes are needed. Present Standard Keyboard machines can be converted by changing typeheads and key cards. The usually cited objection to a general adoption of the improved and Simplified Typewriter Keyboard is that present typists have learned the Standard Keyboard. We have already seen that the average level of typing attainment after one and two years of training on the Standard Keyboard is actually very mediocre. Could the majority of present Standard Keyboard typists, especially those whose performance is low and mediocre, be advantageously retrained on the Simplified Keyboard?

\* This term is used in this report to distinguish the keyboard most generally used from the Simplified Keyboard as developed at the University of Washington.

6 Ibid. Passim

8 National Contest Journal, October, 1941

7 Merrick, N. L. "Typewriting in the University High School," School Review, XLII-4 (April 1941), pp. 284-296



It is claimed (1) that Standard Keyboard typists can learn the Simplified Keyboard at .50 to .75 n.w.p.m. per hour of instruction, (2) that 50 to 60 hours of instruction on the Simplified Keyboard will bring the average typist back to her Standard Keyboard speed and (3) that 100 hours of retraining on the Simplified Keyboard will result in 35% to 50% average improvement in present typist speed.

A year ago in an exploratory experiment fifteen Standard Keyboard typists were retrained on the Simplified Keyboard. The aim of this experiment was to determine (1) whether such retraining is feasible, (2) whether such retraining is profitable, and (3) by what procedure the retraining can best be effected. On January 17, 1944 the retraining of another group of 14 Civil Service typists was begun for securing detailed data on retraining Standard Keyboard typists while on the job.

The typists selected were representative Civil Service typists. Twelve were classified as CAF-2 typists, earning 70¢ per hour (\$1752 per year). Two had CAF-3 ratings (79¢ per hour - \$1970.88 per year). The following data describe the typists and their Standard Keyboard typing on January 17, 1944.

	Range	Average
1. Age - years	17 1-2 to 26 1-2	21.1
2. I. Q. (Otis - S-A Test, Higher Exam. form C)	.79 to 1.14	.98
3. Dexterity--Gottsdanker Mechanical Aptitude Test--typists' percentile norms	31 to 96%ile	65%ile
4. Months of college attendance (chiefly business college)	0 to 36	11
5. Errors per 10-minute test on the Standard Keyboard	8 to 35	17
6. Old Keyboard gross typing speed - (g.w.p.m.)	36.5 to 68	49.9
7. Standard Keyboard net typing speed - (n.w.p.m.)	14 to 60	32.9
8. Hours of previous instruction on the Standard Keyboard	100+ to 960	419+
9. Number of months employed typing experience on Standard Keyboard	0 to 48	19.2
10. Learning rate on Standard Keyboard (in n.w.p.m.) per hour of instruction	.036 to .250	.079

The retraining period was two instruction hours daily--six days per week--86 hours. During the first two weeks of the retraining the typists were employed for six hours per day at gainful work other than typing since as soon as retraining is started typing on the Standard Keyboard is not advisable. On the 13th day, however, and for the next six weeks the typists typed regular office material on their Simplified Keyboard machines for six hours daily. Their average typing speed on the 13th day--after 24 hours of retraining--was 21 net words per minute or 64% of their average Standard Keyboard rate of 32.9 n.w.p.m.

Absences from class reduced the average instruction period to 83 hours. The average time required for the typists to reach their Standard Keyboard net speed was 52 hours. Their average learning rate on the Simplified Keyboard was .70 n.w.p.m. per hour of instruction. At the end of the retraining period their Simplified Keyboard performance was improved over their Standard Keyboard performance by an average of 68% in accuracy and 74% in net typing speed. The following data, illustrated in Figure 4, describe their Simplified Keyboard typing at the end of the retraining period.



TABLE I--DATA COLLECTED FOR 14 CIVIL SERVICE OLD KEYBOARD TYPISTS BEFORE THEIR RE-  
TRAINING ON THE SIMPLIFIED TYPEWRITER KEYBOARD ON JANUARY 17, 1944

Typists	Age	(a) I.Q.	(b) Dexterity test file	Attended College	Months of typing training on Old Keyboard		(c) Approximate hours of training on Old Keyboard	CSC Rating	Old Keyboard Employed Typing Ex- perience	Old Keyboard 10-minute Test Scores		Net Words per hr. of training on Old Keyboard
					H.S.	Col.				Gr.	Net	Er.
1. Ba...	22½	.79	31	---	15	--	300	CAF-2	1 mo.	late enrollment		---
2. Br...	18½	1.14	86	12 mos.	18	12	600	CAF-3	41 mos.	late enrollment		---
3. Ca...	19½	1.03	71	3 yrs.	36	--	720	CAF-2	30 mos.	36.5	26.0	10.5
4. Do...	24½	.98	69	12 mos.	36	12	960	CAF-2	10 mos.	48.5	40.0	8.5
5. Dr...	22	.99	96	3 sem.	18	4½	450	CAF-3	24 mos.	59.0	39.5	19.5
6. Ga...	20½	1.00	71	2 yrs.	18	9	540	CAF-2	7 mos.	54.5	34.0	20.5
7. Jo...	21½	1.03	54	---	27	--	540	CAF-2	15 mos.	52.0	42.5	9.5
8. La...	17½	.93	34	5 mos.	9	5	280	CAF-2	2 mos.	44.0	32.0	12.0
9. Le...	26½	1.05	90	4 yrs.	9	9	360	CAF-2	46 mos.	51.0	34.0	17.0
10. Li...	22½	.99	87	12 mos.	9	12	420	CAF-3	11 mos.	68.0	60.0	8.0
11. My...	20½	1.03	72	---	9	--	180	CAF-2	--	51.0	16.0	35.0
12. Sa...	22	1.00	51	2 sem.	5½	--	100 +	CAF-2	48 mos.	41.5	25.0	16.5
13. Vin..	17½	.81	--	---	12	--	240	CAF-2	17 mos.	38.0	14.0	24.0
14. Viz..	20	.93	31	3 mos.	9	--	180	CAF-2	17 mos.	55.5	32.5	23.0
AVERAGES	21.1	.98	65				419 +		19.2	49.9	32.9	17.0
												.103

(a) Otis S-A test of mental abilities--Higher Examination, Form C.

(b) Gottsdanker Mechanical Aptitude Test--Scores are reported in percentile standing in Author's norms for typists and comptometer operators, --50%ile is average--65%ile class average indicates group was slightly above typist and comptometer operator norms.

(c) Based on full attendance--one hour per--20-day month. Several attended Old Keyboard typing classes 2 hours per day.



Their Standard Keyboard data are presented for comparison:

1. Number of hours of retraining on Simplified Keyboard (Standard Keyboard)	64 to 96 (100+ to 960)	83 (419)
2. Simplified Keyboard gross typing speed (g.w.p.m.) (Standard Keyboard)	49 to 78 (36 to 68)	62.6 (49.9)
3. Errors per 10-minute test--Simplified Keyboard (Standard Keyboard)	2 to 13 (8 to 35)	5.4 (17)
4. Net Speed (n.w.p.m.)--Simplified Keyboard (Standard Keyboard)	47 to 76 (14 to 60)	57.1 (32.9)
5. Learning rate in n.w.p.m. per hour of instruction (Standard Keyboard)	.55 to .89 (.036 to .250)	.70 (.079)
6. Increase over Standard Keyboard in gross speed	4 to 64%	25%
7. Increase in accuracy over Standard Keyboard--or decrease in errors per 10-minute test	13 to 92%	68%
8. Increase over Standard Keyboard in net typing speed	19 to 244%	74%

An analysis of the individual records shows that the best improvement in net speed was secured with typists whose Standard Keyboard net rates were less than 30 n.w.p.m. Obviously, at .70 n.w.p.m. per hour of instruction, a typist requires only 40 hours on the Simplified Keyboard to reach her Standard Keyboard net speed of 28 n.w.p.m. But 100 hours are required on the Simplified Keyboard to reach a fast typist's Standard Keyboard net speed of 70 n.w.p.m. The best typist in the group, after 420 hours of instruction on the Standard Keyboard, had a net speed of 60 n.w.p.m. Her over-all Simplified Keyboard learning rate was .79 n.w.p.m. per hour of instruction. She reached her Standard Keyboard rate of 60 n.w.p.m. in 66 hours. But because of her high Standard Keyboard net rate, her final Simplified Keyboard net rate of 71 (the second highest in the group) represents only a 19% gain in net speed, the lowest relative gain in the group. On the other hand, the four poorest Standard Keyboard typists in an average retraining time of 78 hours on the Simplified Keyboard, improved their net typing speed by 110%, 119%, 236%, and 244%, respectively.

In an emergency the best practical results in the shortest time will be secured on the Simplified Keyboard by retraining the poorer Standard Keyboard typists. The best Standard Keyboard typists can be advantageously retrained on the Simplified Keyboard, but more time will be required. When Standard Keyboard typists average 32.9 n.w.p.m., any typist who can type at 60 n.w.p.m. on any keyboard is relatively rare and quite valuable. On the Standard Keyboard only one typist in this group had exceeded 43 n.w.p.m. On the Simplified Keyboard, however, nine of the fourteen typists, after 83 hours training were typing at 55 to 76 n.w.p.m., seven at 57 n.w.p.m. or better, and three at 64 n.w.p.m. or better.

How well would these typists have been typing after an equal amount of additional training on the Standard Keyboard? The Navy Department has been teaching continuation classes in Standard Keyboard typing. The result of such training has been approximately .15 n.w.p.m. per hour of instruction. It is to be remembered that those typists have already had an average of 419 hours of training on the Standard Keyboard. It is not to be expected that the kind of training that had previously given mediocre results would suddenly give outstanding results. Since the Standard Keyboard problems and limitations discovered by the Carnegie Investigation are unchanged in continuation training, and since an average of 19 months of typing experience on the Standard Keyboard resulted in little or no growth in typing speed, continuation or additional training can not be expected to produce more improvement in net speed per hour of instruction than was secured from initial training on the same Standard Keyboard. Surveys of Standard Keyboard typing (see page 1) show that in the third year of typing instruction--180 hours--students increased their typing performance from the

TABLE II--DATA ON SIMPLIFIED KEYBOARD TYPING SCORES FOR 14 STANDARD KEYBOARD TYPISTS WHO WERE RETRAINED ON THE SIMPLIFIED KEYBOARD  
(January 17 - March 11, 1944)

Typists	Simplified Keyboard 10-Minute Typing Test Score Final Week			Hours of Retraining on Simplified Keyboard	Net Words Per Minute Per Hr. of Retraining
	Gr.	Net	Errors		
1. Ba.....	59	51	8	88	.58
2. Br.....	78	76	2	86	.88
3. Ca.....	60	57	3	64	.89
4. Do.....	61	57	4	80	.71
5. Dr.....	77	64	13	76	.84
6. Ga.....	64	55	9	88	.63
7. Jo.....	57	51	6	70	.73
8. La.....	63	59	4	96	.62
9. La.....	53	48	5	86	.56
10. Li.....	78	71	7	90	.79
11. My.....	59	55	4	78	.70
12. Sa.....	56	51	5	82	.62
13. Vin....	49	47	2	86	.55
14. Viz....	62	58	4	90	.64
AVERAGES	62.6	57.1	5.4	83	.70



TABLE III--COMPARISON OF OLD KEYBOARD AND SIMPLIFIED KEYBOARD TYPING SCORES, HOURS OF TRAINING ON EACH KEYBOARD, NET WORDS PER MINUTE PER HOUR OF TRAINING ON EACH KEYBOARD, AND "% GAINS" IN GROSS SPEED, NET SPEED, AND ERRORS FOR 14 OLD KEYBOARD TYPISTS WHO WERE RETRAINED ON THE SIMPLIFIED KEYBOARD (JANUARY 17 - MARCH 11, 1944)

Typists	Old Keyboard 10-minute typing test scores		Simplified Keyboard 10-minute typing test scores		Hours training on Old Keyboard	Hours training on Simplified Keyboard	Net words per minute on Old Keyboard	Net words per minute on Simplified Keyboard	Gain in GROSS words per minute	% gain in GROSS words per minute	Decrease in ERRORS per 10-minute test	% gain in accuracy	Gain in NET words per minute	% gain in NET words per minute
	Gr.	Net	Gr.	Net										
1. Ba...	---	---	---	51	59	8	88	.58	---	---	---	---	---	---
2. Br...	---	---	---	76	78	2	86	.88	---	---	---	---	---	---
3. Ca...	36.5	26.0	10.5	57	60	3	64	.89	23.5	64	7.5	71	31.0	119
4. Do...	48.5	40.0	8.5	57	61	4	80	.71	12.5	26	4.5	53	17.0	43
5. Dr...	59.0	39.5	19.5	64	77	13	76	.84	18.0	29	6.5	32	24.5	62
6. Ga...	54.5	34.0	20.5	55	64	9	88	.63	9.5	17	11.5	56	21.0	62
7. Jo...	52.0	42.5	9.5	51	57	6	70	.73	5.0	10	3.5	37	8.5	20
8. La...	44.0	32.0	12.0	59	63	4	96	.114	19.0	43	8.0	75	27.0	84
9. Le...	51.0	34.0	17.0	48	53	5	86	.094	2.0	4	12.0	71	14.0	41
10. Li...	68.0	60.0	8.0	71	78	7	90	.79	10.0	15	1.0	13	11.0	19
11. My...	51.0	16.0	35.0	55	59	4	78	.089	8.0	16	31.0	89	39.0	244
12. Sa...	41.5	25.0	16.5	51	56	5	82	.250	14.5	35	11.5	70	26.0	104
13. Vin..	38.0	14.0	24.0	47	49	2	86	.058	11.0	30	22.0	92	33.0	236
14. Viz..	55.5	32.5	23.0	58	62	4	90	.64	6.5	12	19.0	83	25.5	78
AVERAGES	49.9	32.9	17.0	62.6	57.1	5.4	83	.70	11.6	25	11.5	62	24.6	93*
COMPARISON OF AVERAGES	49.9	32.9	17.0	62.6	57.1	5.4			12.7	25+	11.6	68	24.2	74**

\*Average "% gain in net words per minute" is unduly influenced by large "% gains" for Cases #3, 11, 12, and 13

\*\*When group averages (columns 2-7) are compared, the "% gains" become in gross w.p.m. - 25+%, in accuracy - 68%, and in net words per minute - 74%



second year average of 40.4 n.w.p.m. to the third-year average of 47 n.w.p.m., or 6.6 n.w.p.m.--.036 n.w.p.m. per hour of instruction. Consequently, to assume that after 83 hours of additional instruction these typists would have improved their average Standard Keyboard speed by  $83 \times .15$ , or about 12 n.w.p.m., is more than reasonable. Their Standard Keyboard rate would, therefore, have been about 45 n.w.p.m., or 12 n.w.p.m. less than their Simplified Keyboard average speed of 57.1 n.w.p.m. The average net speed of 57.1 n.w.p.m. on the Simplified Keyboard is 127% of their assumed potential Standard Keyboard rate after 83 additional hours of instruction which, incidentally, would have brought their total Standard Keyboard instruction to  $83 + 419$  or 502 hours.

Analysis of the individual records indicates that a minimum of 100 hours should be given to retraining on the Simplified Keyboard if outstandingly profitable results are to be secured. Obviously, there is no point to retraining typists on the Simplified Keyboard if they do not become faster and more accurate typists and if they can not type more easily and with less fatigue than they did on the Standard Keyboard. After 100 hours of retraining on the Simplified Keyboard the group average should be  $100 \times .70$  n.w.p.m., or 70 n.w.p.m. Whereas 100 hours of additional training on the Standard Keyboard with a similar group would give an average of  $32.9 \text{ n.w.p.m.} + (100 \times .15 \text{ n.w.p.m.})$ , or about 48 n.w.p.m. After 100 hours of retraining, the comparison between the Standard and the Simplified groups could be 70 to 48, or 146%, in the Simplified Keyboard group's favor. The percentage improvement in favor of the Simplified Keyboard, evidenced by the steady upward trend in net speed (Figure 4), would continue to increase for comparisons between increased instruction of present typists on the Standard and the Simplified Keyboards until diminishing returns and physiological limits were reached.

What did it cost to retrain these 14 typists on the Simplified Keyboard? Did it pay to do so? It is difficult to evaluate properly an improvement in a sadly needed commodity or service. But these typists were being paid \$1752, or more, per year and they were turning out a certain amount of work on the Standard Keyboard. If their typing on the Standard Keyboard was worth the price paid for it, then an increase in the amount of work done on the Simplified Keyboard should be worth an equivalent price. Consequently, the value of each typist's increase in typing rate was computed at the hourly pay rate received on the Standard Keyboard prior to retraining.

Typewriters were converted by purchasing new sets of type bars, installing them, and aligning the type. At the same time each typewriter also received a thorough inspection and overhaul. One make of typewriter was converted for \$15.00 per machine; another, at a higher figure. In the computations \$20.00 was credited as the cost of machine conversion, and \$13.69 as the prorated instructor cost. Hours in class were charged to "cost" at the typist's pay scale, 70¢ or 79¢ per hour. On the 13th day the typists began their regular typing for 6 hours per day with an average efficiency of 64% of their Standard Keyboard rate. It took these typists from 16 to 33 days (32 - 66 hours) to reach 100% of their Standard Keyboard net rates. This number of days was determined for each typist and a 25% loss of efficiency was charged for the six hours daily that they typed at less than their Standard Keyboard net rate (18% would have been more accurate since 64% to 100% averages 82%).

Likewise, "percentage gain" in typing net speed and the number of hours during the training period that the typists typed at increased efficiency was computed. The value of the increased typing efficiency during the retraining course was computed as a credit toward the final cost of the retraining. The following data present the costs and financial advantages of Simplified Keyboard retraining, per individual, for this group of 14 typists:



	Ranges	Averages
1. Cost of typists' hours in retraining class	\$44.80 to \$67.94	\$59.62
2. Cost of machine conversion	20.00	20.00
3. Cost of instructor	13.69	13.69
4. Cost of decreased typing efficiency during early part of the retraining period	4.74 to 27.32	12.07
5. Total cost of retraining	84.79 to 128.49	105.38
6. Value of increased production during latter part of the retraining period	1.68 to 158.59	52.80
7. Net cost of retraining on Simplified Keyboard	-60.50* to 121.29	52.58
8. Value per day of the final "% gain" in net typing efficiency computed at typist's daily wage	1.12 to 13.66	5.12
9. Number days after retraining required to amortize net cost of retraining	-10.8 to 101.0	10.3
10. Value of increased efficiency per typist--1st four months after retraining	3.61 to 1480.19	479.89
11. Total value of increased efficiency--entire group--1st four months after retraining ended and costs are amortized		\$6718.19
12. Value of increased typist efficiency 2nd four months (7/11/44 to 11/11/44) with costs of retraining amortized in 1st four months	116.48 to 1421.06	532.45
13. Total value of increased efficiency--entire group--2nd four-month period after retraining--(7/11/44 to 11/11/44)		\$7454.31

It is impossible to evaluate properly all the advantages of increased production. In the above costs, machine conversion to the Simplified Keyboard was charged to "costs." But the total value of increased efficiency--\$7454.31--would pay the wages of 13 similarly paid typists for four months. Therefore, these 14 retrained typists are capable of turning out as much typewritten work as 27 typists with the average ability possessed by this group on the Standard Keyboard on January 11, 1944. To turn out on the Standard Keyboard the additional amount of work would, therefore, require 13 additional typists, 13 additional typewriters, 13 additional desks and chairs, and enough space for 13 desks. Still, conversion of the 14 typewriters was counted as a "Cost."

How permanent were the "gains in new typing speed?" Were those "gains" in net typing speed reflected in the typists' office production? What were the typists' reactions to the Simplified Keyboard after they had used it in their office work for two or three months?

To determine the permanence of the typing speed gained in the retraining class

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\* Two typists through increased production amortized their "cost of retraining" before the 8-week retraining period was completed.



TABLE IV--INDIVIDUAL AND AVERAGE COSTS OF SIMPLIFIED KEYBOARD RETRAINING FOR  
FOURTEEN OLD KEYBOARD TYPISTS (JANUARY 17 - MARCH 11, 1944)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Civil Service Rating (CAR)	Hours Simplified Key- board training	Number days typing at average 75% efficiency during retraining	Number hours typing at 75% efficiency during retraining	Per hour rate of pay	Cost of hours for Simplified Keyboard training	25% loss in production through lowered typing efficiency during train- ing	Instructor and machine conversion cost	Cost outlay for re- training (Col. 7 & 9)	Number days typing at increased efficiency during training	Number hours typing at increased efficiency during training	Average per cent in- crease in typing efficiency	Value of increased typing efficiency during re- training	Final total cost of re- training (Col. 10 - Col. 13)
1. Be.... (b)	2	88	14	84	\$ .70	\$61.60	\$14.70	\$33.69	\$109.99	22	132	37	\$ 34.19	\$ 75.80
2. Br.... (b)	2	86	14	84	.79	67.94	16.99	33.69	118.22	22	132	37	38.58	79.64
3. Co....	2	64	6	36	.70	44.80	6.30	33.69	84.79	30	180	59.5	74.97	9.82
4. Do....	2	80	8	48	.70	56.00	8.40	33.69	98.09	28	168	21.5	25.28	72.81
5. Dr....	3	76	4	24	.79	60.04	4.74	33.69	98.47	32	192	31	27.02	51.45
6. Ga....	2	88	14	84	.70	61.60	14.70	33.69	109.99	22	132	31	28.64	81.35
7. Jo....	2	70	32	192	.70	49.00	27.32	33.69	110.01	4	24	10	1.68	108.33
8. La....	2	96	4	24	.70	4.20	4.20	33.69	105.09	32	192	42	56.45	48.64
9. Le....	2	86	14	84	.70	60.20	14.70	33.69	108.59	22	132	20.5	18.94	89.65
10. Li....	3	90	20	120	.79	71.10	23.70	33.69	128.49	16	96	9.5	7.20	121.29
11. My....	2	78	6	36	.70	54.60	6.30	33.69	94.59	30	180	122	153.72	59.13-(1)
12. Sa....	2	82	14	84	.70	57.40	14.70	33.69	105.79	22	132	52	48.05	57.74
13. Vin....	2	86	4	24	.70	60.20	4.20	33.69	98.09	32	192	118	158.59	60.50-(1)
14. Vi2....	2	90	8	48	.70	63.00	8.40	33.69	105.09	28	168	39	45.86	59.23
AVERAGES		83	11.6(j)	69.5	\$ .7193	\$59.62	\$12.07	\$33.69	\$105.38	24.43	146.6	37	\$ 52.80	\$ 52.58

(a) "75%" is a low estimated average. The group average net words per minute on the first typing day (January 31, 1944) was 20.8 net words per minute or 63% of the group Old Keyboard average on January 17. See Text. Typists typed six hours per day on regular work after the first two weeks of retrain-  
ing.

(b) Column 3 times Column 6.

(c) The "25% loss in typing efficiency" before the typists reached their Old Keyboard net words per minute is a high estimate. See Note (a) above.

(d) See text. This cost is made up of \$20.00 for machine conversion and \$13.69 for instructor cost.

(e) This is the actual number of days during the retraining course after the typists reached their Old Keyboard net words per minute. As in Columns 4 & 5 -  
typists typed six hours per day on regular work.

(f) This is 1/2 of the final % gain in net words per minute."

(g) This is the value of the typist's increase in typing efficiency at her current rate of pay.

(h) These two typists enrolled late and did not take the Old Keyboard tests for comparison with their Simplified Keyboard scores. All computations are  
therefore based on the averages of the group.

(i) Because of their low Old Keyboard efficiency and their high efficiency on the Simplified Keyboard, the value of these typists' work, during the retrain-  
ing period exceeded the total cost of the retraining.

(j) This average is influenced by the unusually low figures for Nos. 3, 5, 8, 11, & 13. Figure 1 indicates that this average is closer to 14.



TABLE V--DATA ON DOLLAR VALUE OF "% GAINS IN NET WORDS PER MINUTE," AMORTIZATION OF RETRAINING COSTS, AND DOLLAR VALUE OF INCREASED TYPIST EFFICIENCY IN FIRST AND SECOND FOUR-MONTH PERIODS AFTER RETRAINING FOR FOURTEEN OLD KEYBOARD TYPISTS WHO WERE RETRAINED ON THE SIMPLIFIED KEYBOARD (JANUARY 17 - MARCH 11, 1944)

1	2	3	4	5	6	7	8
Typists	Daily Wage for eight hours	Final "% gain in net words per minute" (Table III)	Value of "% gain in net words per minute" per 8-hour day	Final net cost of retraining - Jan. 17 - March 11, 1944 (Table IV)	Number days required after retraining to amortize individual costs of retraining	Projected value of increased production first 4 months after retraining--March 12 - June 12, 1944.	Projected value of increased production second 4 months after retraining, when costs are amortized June 12 - Sept. 1944
1. Ba....	\$5.60	74	\$ 4.144	\$ 75.80	18.3	\$ 355.18	\$ 430.98
2. Br....	6.32	74	4.677	79.64	17.0	406.77	486.41
3. Ca....	5.60	119	6.664	9.82	1.5	683.24	693.06
4. Do....	5.60	43	2.408	72.81	30.2	177.62	250.43
5. Dr....	6.32	62	3.918	51.45	13.1	356.02	407.47
6. Ga....	5.60	62	3.472	81.35	23.4	279.74	361.09
7. Jo....	5.60	20	1.120	108.33	96.7	8.15	116.48
8. La....	5.60	84	4.704	48.64	10.3	440.58	489.22
9. Le....	5.60	41	2.296	89.65	39.0	149.13	238.78
10. Li....	6.32	19	1.201	121.29	101.0	3.61	124.90
11. My....	5.60	244	13.664	59.13-(a)	10.6-(a)	1480.19	1421.06
12. Sa....	5.60	104	5.824	57.74	9.9	547.96	605.70
13. Vin...	5.60	236	13.216	60.50-(a)	10.8-(a)	1434.96	1374.46
14. Viz...	5.60	78	4.368	59.23	13.6	395.04	454.27
AVERAGES			\$ 5.12	\$ 52.58	25.2 (b)	\$ 479.87	\$ 532.45
GROUP TOTALS			\$71.68	\$737.12	10.3	\$6718.19	\$7454.31

TOTAL FOR 8 MONTHS PER TYPIST----- \$1012.32

TOTAL FOR 8 MONTHS FOR 14 TYPISTS --- \$14,172.50

- (a) (See Table IV) This typist by virtue of her low Old Keyboard efficiency, and her marked increase of efficiency on the Simplified Keyboard, had amortized the whole cost of her Simplified Keyboard retraining before the retraining period was completed.
- (b) This average is unduly influenced by the high figures for Nos. 7 & 10, Column 4 & 5 "averages" & "totals" give 10.3.

on the Simplified Keyboard the available typists were retested eight to ten weeks after the end of the retraining class (May 11 - May 24). The results of the retesting showed that some of the typists had actually increased their Simplified Keyboard typing speed, while on the job. The average of all the typists' retest scores showed that the group had retained the high net typing speed gained in the 83-hour retraining class. This is in contrast to the results familiar to employers of Standard Keyboard typists whose typing speed and production rates rarely equal their final class test scores and frequently suffer decreases of 50% or more.

Comparable and detailed production records were available for only one typist. Those were the records for the one 60-net-word-per-minute Standard Keyboard typist whose high Standard Keyboard record enabled her in 90 hours to make only a 19% increase in net typing speed. Her production records, unequally divided between typing letters and manuscript typing, over comparable five-week periods on the two keyboards, showed a 9% improvement in letter typing and a 36% improvement in manuscript typing on the Simplified Keyboard.

Typists who have had practical experience with both keyboards are best qualified-- actually are the only persons qualified--for opinions relative to the practical merits of the Simplified Keyboard for the typist. It is to be remembered that the fourteen typists had had an average of 419 hours (range 100+ to 960 hours) instruction on the Standard Keyboard. They had an average of 19 months (range 0 - 48 mos.) of employed experience on the Standard Keyboard. After an average of 83 hours instruction and three months of employed experience on the Simplified Keyboard they were asked to express their reactions to the retraining on the Simplified Keyboard.

The typists were unanimous in their approval of the Simplified Keyboard. Their reasons, appended in their entirety, may be summarized as follows:

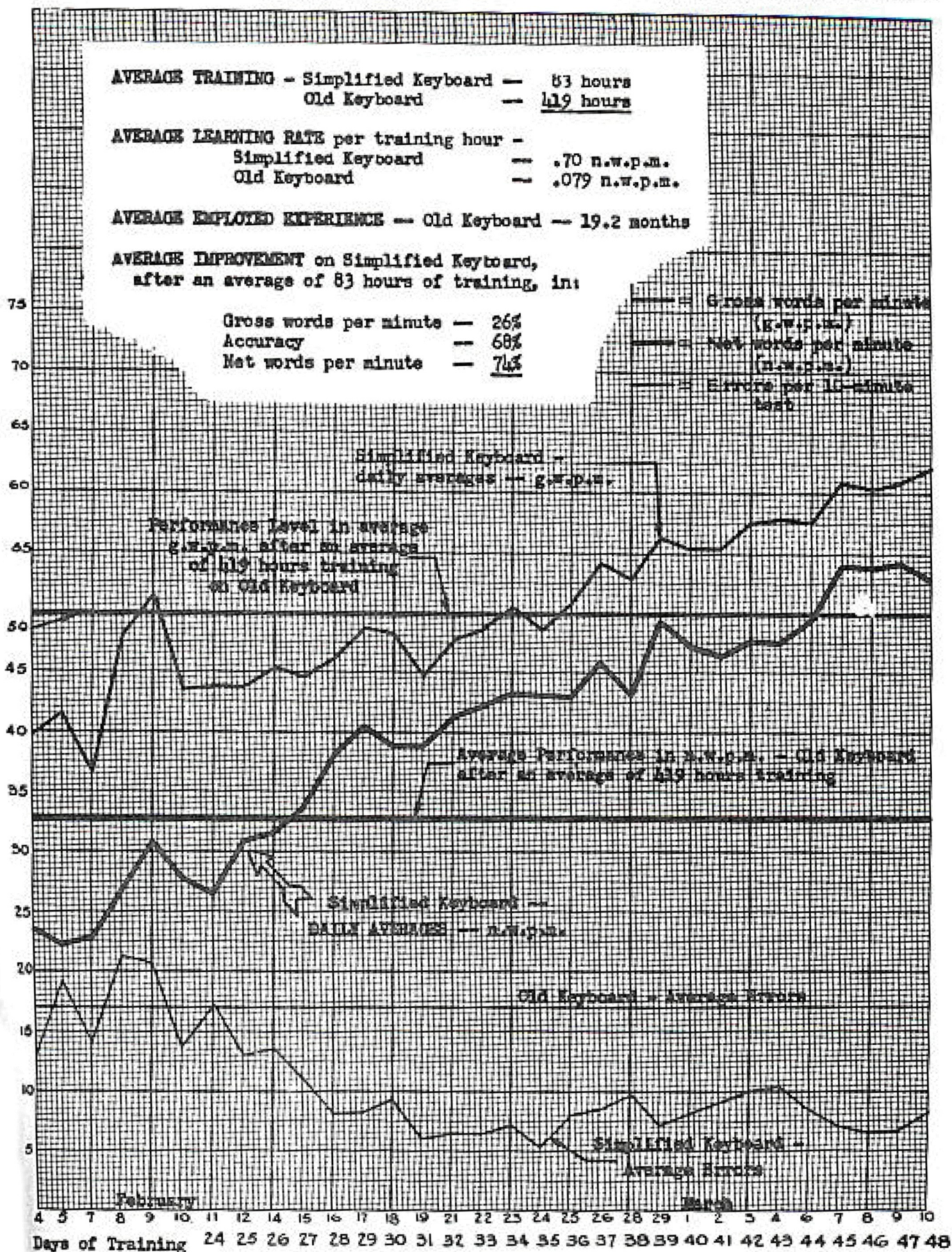
1. Typing on the Simplified Keyboard is easy to learn.
2. Typing on the Simplified Keyboard is more accurate.
3. Typing on the Simplified Keyboard is less fatiguing.
4. The greater efficiency of typing on the Simplified Keyboard has brought the typist recognition and rewards (better pay and monthly awards).
5. Typing on the Simplified Keyboard is easier and more enjoyable.
6. Typing on the Simplified Keyboard requires less tension and strain.
7. Faster and more accurate typing on the Simplified Keyboard leaves time for other necessary work and relieves the typists of the pressure from unfinished daily work.

It is noteworthy that supervisors and employers had in the main noted similar reactions relative to these retrained Simplified Keyboard typists.

Since these typists had had only 83 hours of instruction on the Simplified Keyboard, i.e., one fifth of the 419 hours of instruction that they had had on the Standard Keyboard, it is believed that training of beginning typists and retraining of typists whose skill is mediocre or poor is a practical solution to the present shortage of competent typists.



# RETRAINING PROGRESS CURVES ON THE SIMPLIFIED KEYBOARD FOR FOURTEEN TYPISTS





EXCERPTS FROM LETTERS FROM RETRAINED SIMPLIFIED KEYBOARD TYPISTS  
AND FROM SOME OF THEIR SUPERVISORS

1) "I am glad to report my experience in using the Simplified Keyboard.

"I do not regret converting to the Simplified Keyboard, and from my personal experience it's something I wished for, as typing on the Old Keyboard had me on the point of resigning from typing.

"Now that I have completed the course in Simplified Typewriting, I am more interested both in Typing and my work.

(a) No fatigue at all, and I can prove this as I am now trying to get another job after my eight hour per day period.

(b) I have accomplished more accuracy, especially when concentrating during writing.

(c) Typing is easier, as my fingers do not wander all over the Keyboard, but do their duty simultaneously.

(d) There is a vast increase in production, my Supervisors and Seniors can second this motion, along with a Monthly Award I received yesterday.

(e) I do feel less tension than I did formerly, and would advise other typists to convert to this easy method, and not be a mere typist but a Champion or an Expert." -- (E. L. Ba.)

2) "Since I have been typing on the Simplified Keyboard, I enjoy my work. It's a pleasure to know you are working with something much simpler and more enjoyable.

"Yes, I make fewer errors, in fact, I don't make one third of the errors on this keyboard that I did on the Standard machine.

"It certainly is a pleasure to sit down and type when you know at the end of the day you will be ready for an evening of pleasure, in other words, I find at the close of the day at the office, I am less tired and I can finish my work in much less time on the Simplified than I did on the Standard Keyboard. Also there is a noticeable difference in finger fatigue.

"The way the keys are replaced, one finger has as much work as the other one.

"Another difference is wrist movements. A great difference is noticed there. Much less movements and less fatigue.

"I am very glad I have had the pleasure and privilege of being able to convert to the new keyboard. Any one that has the same privilege will never be sorry, this I am sure." -- (N. Br.)

3) "In March I was fortunate enough to join a new typing class just being formed. We were to be taught the new keyboard better known as the Dvorak keyboard. In my opinion it has been of great value to me from the standpoint of greater accuracy, which is most profitable to any typist. There are other noted advantages too, such as less exhaustion, and less tension while typing, due to the fact that the keyboard has been simplified to perfection.



3 cont.) "Because of my experiences with the new keyboard I would say that any good typist would be justified in converting to the new system. A fair typist would become a better typist, and a poor typist has even a better chance for improvement."

-- (I. A. Ca.)

4) "I am definitely in favor of the Simplified Keyboard.

"It does not seem possible that after only six weeks of training I would be typing 57 to 62 words a minute in comparison to typing 45 to 50 words on the Standard Keyboard after a four year typing course.

"As most of the typing is done on the home keys, there is less fatigue and exhaustion at the end of a working day. I also notice a daily increase in my speed with a very low error count, whereas on the Standard Keyboard I was compelled to type at a slow rate of speed to attain accuracy.

"I certainly would advise other typists to retrain." -- (M. F. Do.)

5) "I am very well pleased that I converted from the Standard keyboard to the Simplified Keyboard, as my speed has increased somewhat and my errors have been cut down. I can also feel less tension and fatigue in doing my work, inasmuch as my fingers do not have to travel around over the keys like they did on the Standard Keyboard, and it makes typing much easier.

"I have found that it has speeded up my production of work, and has given me more time for other duties.

"It was a pleasure to have the opportunity to convert to the Simplified Keyboard." -- (C. M. Dr.)

6) "In my opinion, the Simplified Keyboard is 'Tops.' Since I have been using the Simplified Keyboard, I have found that my errors are greatly decreased; also there is much less fatigue at the end of a working day.

"I have gained much more speed since using this keyboard, which naturally makes the production greater.

"I am definitely not sorry that I converted and my advice to anyone is 'Retrain.'" -- (N. La.)

7) "After using the Dvorak Simplified Keyboard for the past two and one-half months, I have come to the following conclusions:

"I feel as if I am doing very well on this machine in comparison to the Standard Keyboard which I have been using for seven years.

"My records show an increase in production. This may be partially due to the fact that I am more familiar with my work.

"I feel more at ease while using this machine and I believe the tension is less.

"I do not regret that I have converted, although I was very competent on the Standard Keyboard." -- (H. Li.)



8) "After taking an eight-week course and using my knowledge of Simplified typing on the job for a period of two months, I find that my typing has been improved in many ways. I would advise other typists to retrain for their own efficiency and greater accomplishment in future production for the following reasons: (1) Increased production daily which leaves more time for other duties and learning the job in all capacities; (2) Less tension in typing than usually experienced in former methods; (3) Fewer errors because of the ease with which you type; (4) Better relaxation during typing which brings less exhaustion at the end of the working day; (5) More speed and accuracy may be attained than would be possible in other methods.

"Since having experienced all these improvements, I am not sorry that I converted to the new Simplified Keyboard and feel sure that other typists would enjoy the same satisfaction." -- (H. My.)

9) "It gives me a great deal of pleasure to give you my candid reaction on the use of the Simplified Keyboard.

"Now, more so than ever, I can tell you how much it means to me. I have been away from the office for three weeks. I was afraid that when I came back I would be all thumbs when I sat down to type, I certainly was surprised. After a few finger exercises I sat down and typed, and it seemed as if I had never left it for that amount of time.

"My typing has become more accurate, my speed has increased and I do not feel that I have to use all my energy just to type a few letters. I can do more work now because it doesn't take me as long to type my letters.

"My next investment will be to have my personal standard typewriter converted."  
-- (B. M. Viz.)

10) "Subj: Information on typist retrained on simplified keyboard - request for.

"Her speed has considerably increased with the simplified keyboard.

"She is more efficient because speed is greater, but not otherwise.

"More work is done with the same amount of strain." -- (I.D. B., Head of Section)

11) "Subj: Report on Miss Sa., typist, Re-trained on Simplified Keyboard.

"I have observed that Miss Sa., the employee, who in this section was selected for re-training, has been made more speedy and more accurate through her course. Her touch is more even and as a result the appearance of her work has improved. She finishes her assignments in less time and is continually seeking new and additional work. Incontrovertible proof of greater speed and less fatigue. Her revived interest in her typing assignments has broadened to include and color the work of the office in general.

"Her increased speed, accuracy and facility allow her to handle at least 30% to 50% more copy work than she was able to produce on the old keyboard. It is through this service that she is able to lighten the work load of the unit, relieving the stenographers of much of the copying required in the handling of correspondence and the maintenance of office records.

"If it were only the value to the trainees themselves in the pride of acquiring new and progressive skill and the revivifying interest in things official I would deem the course highly beneficial. If to this be added the overcoming of fatigue, permitting a



steady and dependable increase in production throughout the day, there can be no doubt of the advantages of the course to both trainee and employee. I would be glad if I might have the opportunity of offering to all the clerks in my unit the privileges of the course."  
--- (H. K., Head of Section)

12) "Subj: Information requested on typist retrained on Simplified Keyboard.

"On the basis of the operator's own statement, the Simplified Keyboard is less fatiguing, as a result of lesser finger motion.

"The operator feels that production has increased."

-- (C. M. S., Head of Section)

13) "Subj: Typist retrained on the Simplified Keyboard.

"Her typing speed has increased somewhat, and the number of errors accordingly have been reduced.

"Her production of work has increased, and she seems to type with less tension and fatigue, and has more time for other duties." -- (W. K. T., Lt. Comdr. USNR)

14) "Subj: Information requested on typist retrained on Simplified Keyboard.

"The attached report covers the production record of Miss Li. for part of 1943 using the Standard Keyboard and for part of 1944 using the Simplified Keyboard. \*

"I fully concur with the statements made by Miss Li. in her letter of 18 May 1944."  
-- (R. B. B., Chief of Section)

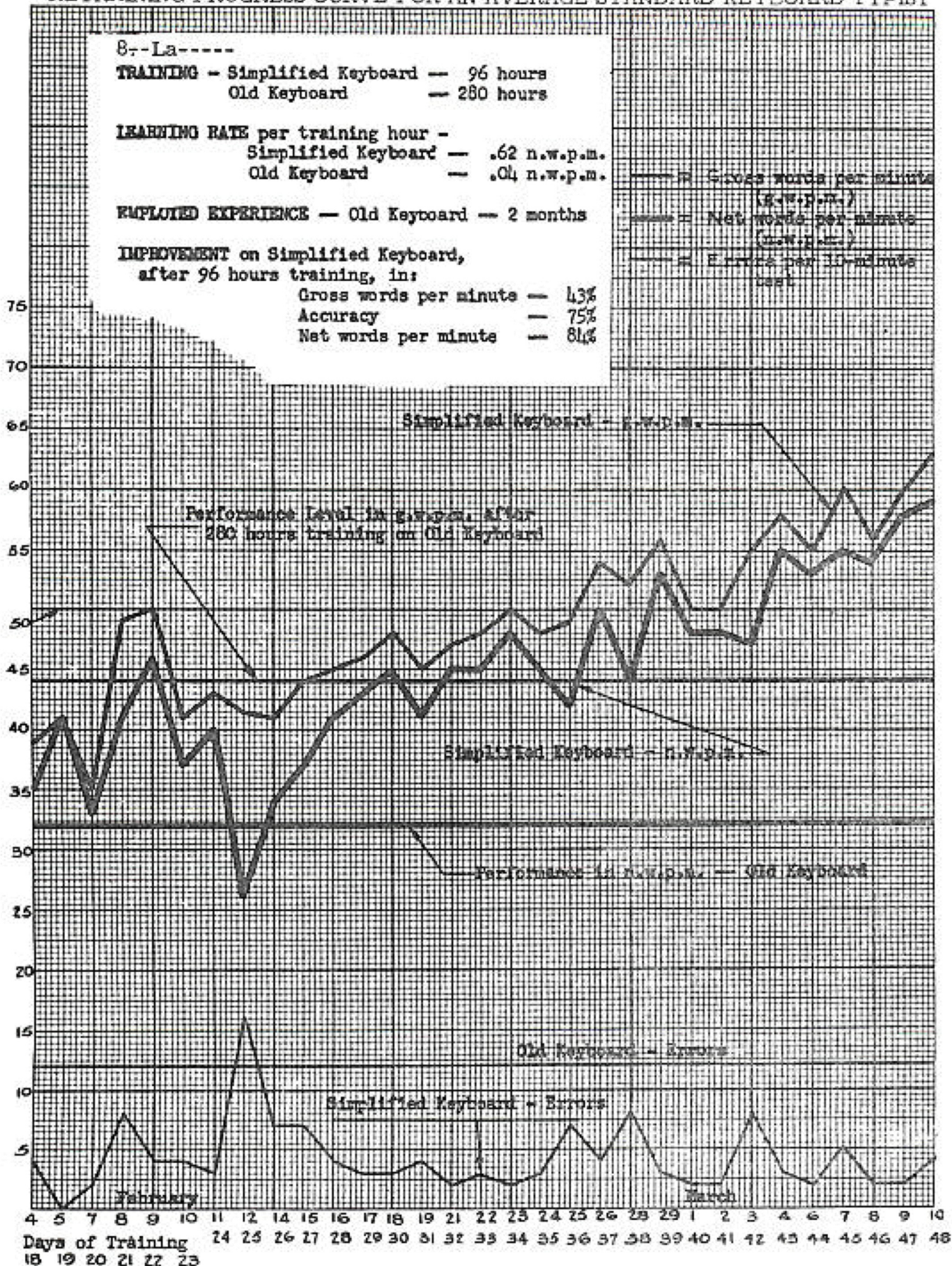
\*(The detailed production report covering comparable five-week periods in 1943 on the Standard Keyboard and in 1944 on the Simplified Keyboard showed a 15% increase in "Average number pages typed per day" on the Simplified Keyboard.

This typist made a score of 60 n.w.p.m. on the Standard Keyboard test before starting retraining on the Simplified Keyboard. Because it took her about 80 hours on the Simplified Keyboard to reach her former high rate, and because her total retraining time was only 90 hours, her final test score on the Simplified Keyboard was 72 n.w.p.m.--a 19% increase in net typing rate. It would have taken her at least 160 hours to reach 120 n.w.p.m. or double her former rate.

It is significant that her 150% increase on the Simplified Keyboard in a comparable five-week production record closely approximated her 19% increase in net typing rate.)

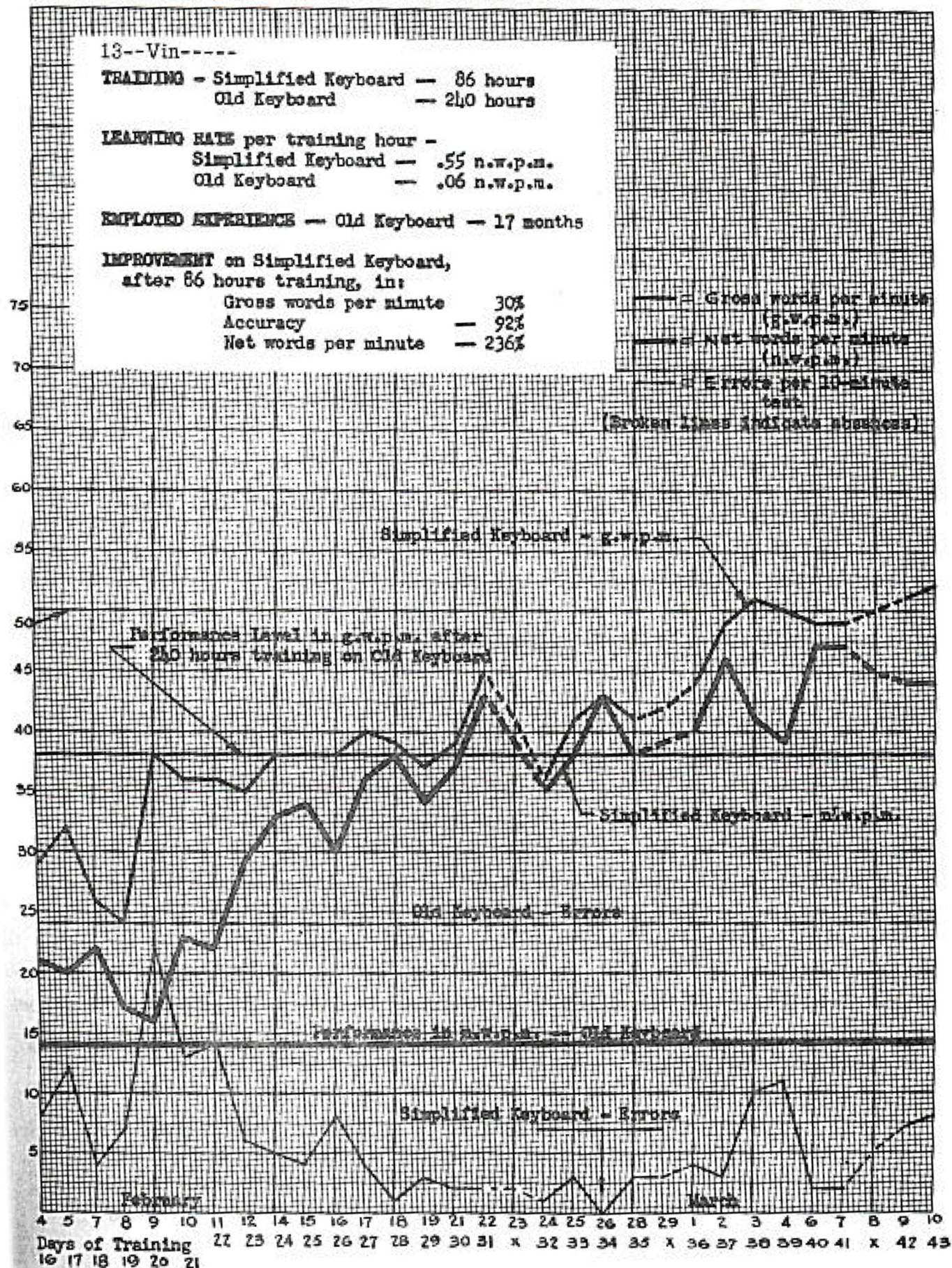


# RETRAINING PROGRESS CURVE FOR AN AVERAGE STANDARD KEYBOARD TYPIST





# RETRAINING PROGRESS CURVE FOR A POOR STANDARD KEYBOARD TYPIST





## II---- A COMPARISON OF TYPIST IMPROVEMENT FROM TRAINING ON THE STANDARD KEYBOARD AND RETRAINING ON THE SIMPLIFIED KEYBOARD

On 13 July 1944 this branch submitted a report entitled "A Practical Experiment in Simplified Keyboard Retraining." This report presented the results secured with 14 Standard Keyboard typists who were retrained on the new Simplified Keyboard.

This report showed that after an average of 83 hours of Simplified Keyboard training, the typists had improved their net typing speed from 32.9 n.w.p.m. on the Standard Keyboard to 57.1 n.w.p.m. on the Simplified Keyboard--an average improvement of 24.2 n.w.p.m., or an average improvement of 74% in net typing speed. The average value of this improvement, calculated at the typists' current pay scales, is \$5.15 per day per typist. The cost of the Simplified Keyboard retraining--calculated at an average of \$52.58 per typist--can be amortized by the value of the increased daily production in 10.3 days after the completion of the training. The potential value of the typists' increased production made possible by the typists' improved typing rates was calculated at \$479.87 per typist in the first four months and \$532.45 in the second four months after the Simplified Keyboard training was completed. Consequently, the total value of the increased production in the first 8 months after the Simplified Keyboard training was completed is \$479.87 + \$532.45 or \$1,012.32 per typist.

Letters and memoranda from the retrained typists indicated that they were happy at having learned to type on the Simplified Keyboard, that they were less fatigued at the end of a day's typing on the Simplified Keyboard than previously on the Standard Keyboard, that they were better able to keep abreast of their daily typing loads, and that they made fewer errors than formerly on the Standard Keyboard. Letters from supervisors confirmed the typists' reports of greater ease, greater speed, greater accuracy, and greater efficiency on the Simplified Keyboard.

The report raised the question--"How well would these typists have done had they been given an equivalent amount of additional training on the Standard Keyboard?" These 14 typists had already had an average of 419 hours instruction on the Standard Keyboard and still their average Standard Keyboard rate was only 32.9 n.w.p.m. The report, quoting various studies from outside sources, indicated that these typists could not have raised their net typing rates by more than 12 n.w.p.m. in 83 hours of additional instruction on the Standard Keyboard. None being available, the report did not cite actual Navy Department results of continuation training on the Standard Keyboard.

On 15 August 1944 a group of 18 Standard Keyboard CAF-2 Navy typists (plus one beginning Standard Keyboard typist) completed a course of training on the Standard Keyboard. Data on the progress of these 18 Standard Keyboard typists had been as carefully compiled as were the data on the 14 Simplified Keyboard typists. The data will be summarized in this Supplementary Report and certain comparisons will be made.

The 18 typists in this group were employed in the Navy Department. All had CAF-2 Civil Service ratings and were paid at the rate of \$1752 per year or \$:70 per hour. This group of typists made an initial average score of 29.2 n.w.p.m., 38.6 gross words per minute - 9.4 errors per 10-minute test. Three typists made zero net scores on the first typing test in the continuation training course. Since on the third or fourth day these three typists made net scores of 13, 29, and 16 n.w.p.m., respectively, without any improvement in gross scores, and since several other typists also made improvements in net scores which were due more to familiarization with test procedure than to improvement in typing skill, an average of the first four tests was used as a measure of typists' initial typing ability. Similarly, their last four tests were averaged to secure a final measure of the typists' improved ability.

The group was given 208 hours of training. Absences made the training per



TABLE I - DATA ON IMPROVEMENT IN TYPEWRITING SCORES FOR 18 STANDARD KEYBOARD TYPISTS WHO WERE GIVEN AN AVERAGE OF 157.6 ADDITIONAL HOURS OF TRAINING ON THE STANDARD KEYBOARD

10-minute typing test score averages							Gain in n.w.p.m. per hour training (3)	
Name	First averages (1) Gross Errors Net	Final averages (2) Gross Errors Net	Gain in n.w.p.m.	% gain in n.w.p.m.	Total hours training	Gain in n.w.p.m. per hour training (3)		
1. Foley	31	11	20	37	7	30	10	.057
2. Hennessey	18	5	13	32	7	25	12	.088
3. Knudson	46	2	44	50	6	44	0	.000
4. Labenski	16	4	12	38	8	30	18	.102
5. Lovelady	33	8	25	38	4	34	9	.051
6. Omholt	44	3	41	49	6	43	2	.032
7. Pressley	25	9	16	36	12	24	8	.045
8. Rabourn	38	15	23	42	13	29	6	.043
9. Savage	47	10	37	54	12	42	5	.057
10. Shipley	52	10	42	55	8	47	5	.057
11. Smith	57	12	45	55	6	49	4	.042
12. Stenborg	52	5	47	54	3	51	4	.042
13. Waddell	36	22	14	45	12	33	19	.108
14. Comly	40	10	30	45	9	36	6	.083
15. Johnsrud	46	9	37	51	7	44	7	.073
16. Sherwood	35	14	21	42	4	38	17	.125
17. Brunold	49	9	40	48	5	44	4	.045
18. Therrien	29	11	18	40	12	28	10	.074
Averages	38.6	9.4	29.2	45.1	7.8	37.3	8.1	.062
							43.1	.062
							(4)	

Average gain gross speed--(38.6 to 45.1)--6.5 g.w.p.m.--17%  
 Average decrease in errors--(9.4 to 7.8)--1.6 errors per 10-minute test--17%  
 Average gain in net speed--(29.2 to 37.3)--8.1 n.w.p.m.--28%  
 (Average of individual % gain in n.w.p.m. is 43.1%)

Average gain in net speed per hour of instruction .062 n.w.p.m.

- (1) Average gross, error and net scores for first four days
- (2) Average gross, error and net scores for final four days
- (3) Since gains in net scores were computed from averages of the first four and the last four days, the gains in n.w.p.m. per hour of training were computed for four days less than the total hours of training
- (4) This average is unduly influenced by typists #2, #4, and #13 whose initial net scores approximated those of beginning typists. Without those three large percentages, due to the exceedingly low first scores the average % gain is 26.5%



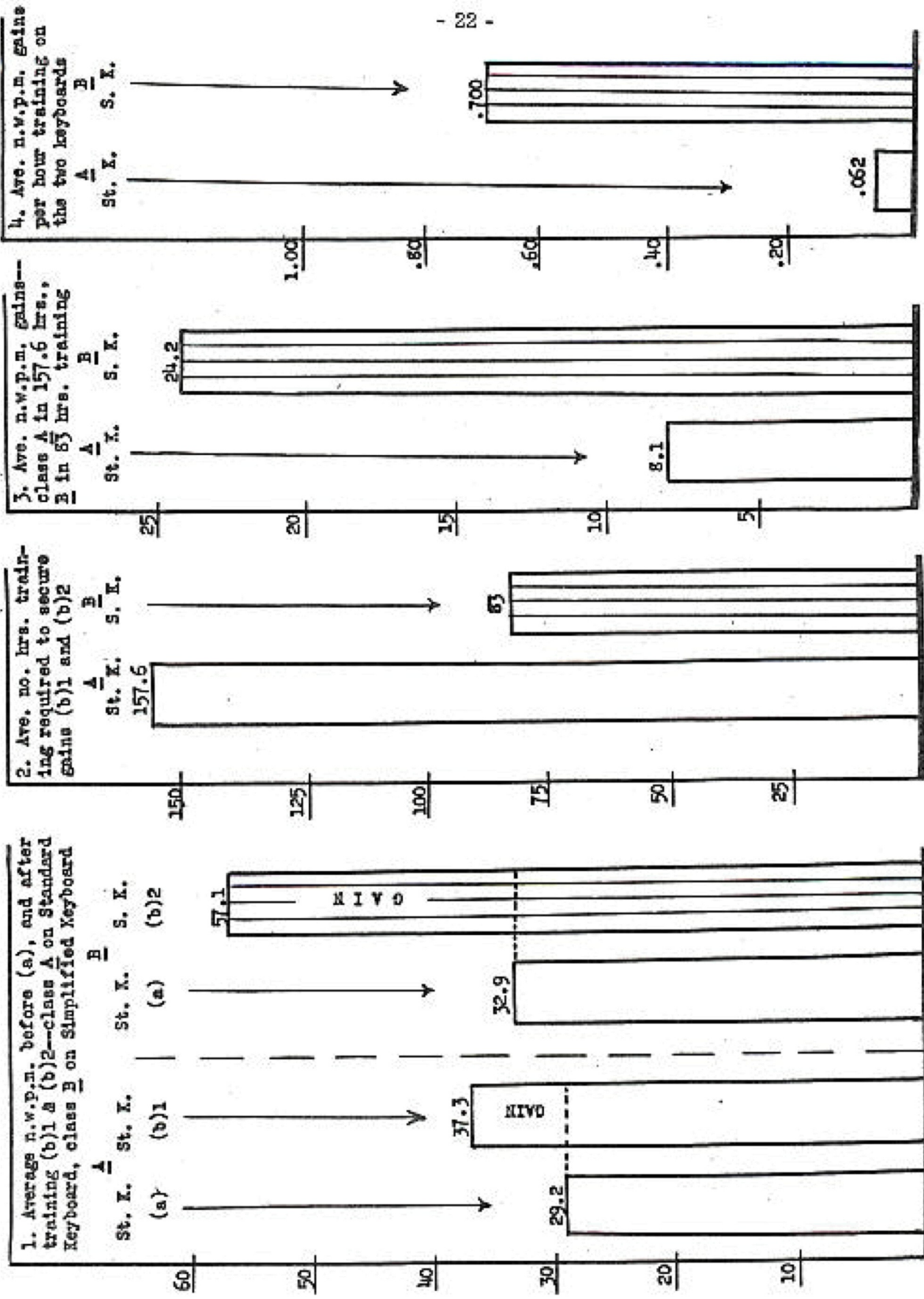


Figure 1. Graphic comparison of improvements in net typing speed (n.w.p.m.)--(A) for 18 Standard Keyboard typists in 157.6 hours additional training on the Standard Keyboard (St. K.) and (B) for 14 Standard Keyboard typists who were given 63 hours retraining on the Simplified Keyboard (S. K.).



typist range from 96 to 208 hours with an average of 157.6 hours for the group. The average of the final scores was 37.3 n.w.p.m., 45.1 gross words per minute - 7.8 errors per 10-minute test. These data detailed in Table I, and illustrated in Figure 1 with comparable Simplified Keyboard data for the 14 Simplified Keyboard retrainees reported in the initial report, show that these Standard Keyboard typists in an average of 157.6 hours of extra training on the Standard Keyboard gained an average of 8.1 net words per minute at a rate of .062 n.w.p.m. per hour of instruction. This 8.1 n.w.p.m. was, of course, added to the typists' previous net score.

The 14 Simplified Keyboard typists progressed at an average of .70 n.w.p.m. per hour of training, but the hourly gain was added to an initial zero score on the Simplified Keyboard. The Simplified Keyboard gain per hour of instruction was .70/.062, or 11.3 times the gain per hour of instruction on the Standard Keyboard. It is obvious that only 29.2/.70, or 42 hours, would have been required on the Simplified Keyboard for these 18 typists to reach an average of 29.2 n.w.p.m. which was the level of their ability on the Standard Keyboard at the start of the training course. After 42 hours on the Simplified Keyboard these typists would have improved their net scores at 11 times their Standard Keyboard rate of improvement. By analogy, if an ox team capable of traveling down a 100-mile boulevard at 2 miles an hour has a 15-hour start on a twenty-two-mile-an-hour jeep, the ox team will be overtaken by the jeep in an hour and a half and will reach its destination 33 1/3 hours behind the jeep at which time the jeep can be 733 1/3 miles beyond the 100-mile mark. No amount of goading the oxen can materially change the end result of a 1100% difference in rate.

Table II (illustrated in Figure 2 together with comparisons with the Simplified Keyboard group) gives in detail the costs and values of the 157.6 hours of additional training given the 18 Standard Keyboard typists. The average of the individual "% gain in n.w.p.m." is 43.1%. If the "% gain in n.w.p.m." is figured from the average "gain" of 8.1 n.w.p.m. and the initial average net rate of 29.2 n.w.p.m., this "percentage gain" in n.w.p.m. is only 28%. If the high "gains" of three typists (#2, #4, and #13) whose initial typing ability approximated that of beginners (14 n.w.p.m. and less) are omitted, the average "% gain in n.w.p.m." for the remaining 15 typists is 28.5%. It is obvious that average "gains" represent larger percentages of small initial scores than similar gains represent of larger initial scores. If the initial scores approximate zero, any "gains" will approximate infinite percentages of the initial scores. At the higher figure, however, the average value of the gain in n.w.p.m. computed at the typists' hourly pay scale is \$2.41 per typist per day. This "average daily value" becomes \$1.41 per typist if the unusually high figures for typists #2, #4, and #13 are omitted and the average is computed for 15 typists. Actually, those three typists with beginners' net scores received credit for half the total daily value of the "gain in n.w.p.m." The average total cost of the additional training was \$143.36 per typist. The elements of this cost are typist time (157.6 hours at \$.70 per hour), the cost of instructor time, and the cost of supplies and machine depreciation.

The average of the individual number of days required to amortize the cost of instruction is 116 days despite the fact that one typist who would have required an infinite number of days to amortize her costs of instruction was disregarded in the computation. Again, if average total cost (\$143.36) is divided by the average daily per-typist value of the improved typing rate (\$2.41), it appears that the costs of instruction could be amortized by the total group in 60 working days. If the average cost of additional training (\$143.36) is divided by \$1.41, it appears that the costs of their instruction could be amortized by 15 members of the group in 102 days.

In the first four months after the additional training was completed, the total value of the gain in net typing rate is projected as \$112.22 per typist after amortizing the costs of instruction. After eight months of employment at the improved typing rates resulting from 157.6 hours of additional training, the value of the increased production is computed as \$357.42 per typist. By comparison, however, the corresponding value per typist after four months employment on the Simplified Keyboard after 83 hours of Simplified Keyboard training was \$479.87. Again by comparison,



TABLE II - DATA ON GAINS IN NET TYPING SPEED, DAILY VALUE OF GAINS IN NET TYPING SPEED, COST OF TRAINING, AMORTIZATION OF COSTS OF TRAINING, AND VALUE OF INCREASED NET TYPING SPEED FOR 18 STANDARD KEYBOARD TYPISTS WHO WERE GIVEN AN AVERAGE OF 157.6 ADDITIONAL HOURS OF TRAINING ON THE STANDARD KEYBOARD BY THE NAVY DEPARTMENT

Names	First n.w.p.m.	Final n.w.p.m.	Gain in n.w.p.m.	% gain in n.w.p.m.	Daily value of "gain in n.w.p.m."	Total hours of additional training	Cost of typists' hours in training	Cost of training other than typists' hours	Total cost of training	No. days required to amortize cost	Projected value of retraining first 4 mos. after retraining	Projected value of retraining first 8 mos. after retraining
1. Foley	20	30	10	50	\$2.80	208	\$145.60	\$33.07	\$178.67	64	\$118.13	\$403.73
2. Hennessey	13	25	12	92	5.15	208	145.60	33.07	178.67	35	367.23	892.53
3. Knudson	44	44	0	0	0.00	136	95.20	33.07	128.27	8	-128.27	-128.27
4. Labenski	13	30	18	150	8.40	208	145.60	33.07	178.67	21	711.73	1568.53
5. Lovelady	25	34	9	36	2.02	208	145.60	33.07	178.67	89	35.45	241.49
6. Omholt	41	43	2	5	.28	96	67.20	33.07	100.27	359	-70.59	-42.03
7. Pressley	16	24	8	50	2.80	208	145.60	33.07	178.67	64	118.13	403.73
8. Rabourn	23	29	6	26	1.46	172	120.40	33.07	153.47	106	1.29	151.67
9. Savage	37	42	5	14	.78	120	84.00	33.07	117.07	150	-34.39	45.17
10. Shipley	42	47	5	12	.67	120	84.00	33.07	117.07	175	-46.05	22.29
11. Smith	45	49	4	9	.50	128	89.60	33.07	122.67	246	-69.67	-18.67
12. Stenborg	47	51	4	9	.50	128	89.60	33.07	122.67	246	-69.67	-18.67
13. Waddell	14	33	19	136	7.62	208	145.60	33.07	178.67	24	629.05	1406.29
14. Comly	30	36	6	20	1.12	104	72.80	33.07	105.87	96	12.85	112.09
15. Johnsrud	37	44	7	19	1.06	128	89.60	33.07	122.67	116	-10.31	97.81
16. Sherwood	21	38	17	81	4.54	168	117.60	33.07	150.67	34	330.57	793.65
17. Brunold	40	44	4	10	.56	120	84.00	33.07	117.07	210	-57.71	-.59
18. Therrien	18	28	10	56	3.14	168	117.60	33.07	150.67	48	182.17	502.45
Averages	29.2	37.3	8.1	43.1	\$2.41	157.6	\$110.29	\$33.07	\$143.36	116+	\$112.22	\$357.40



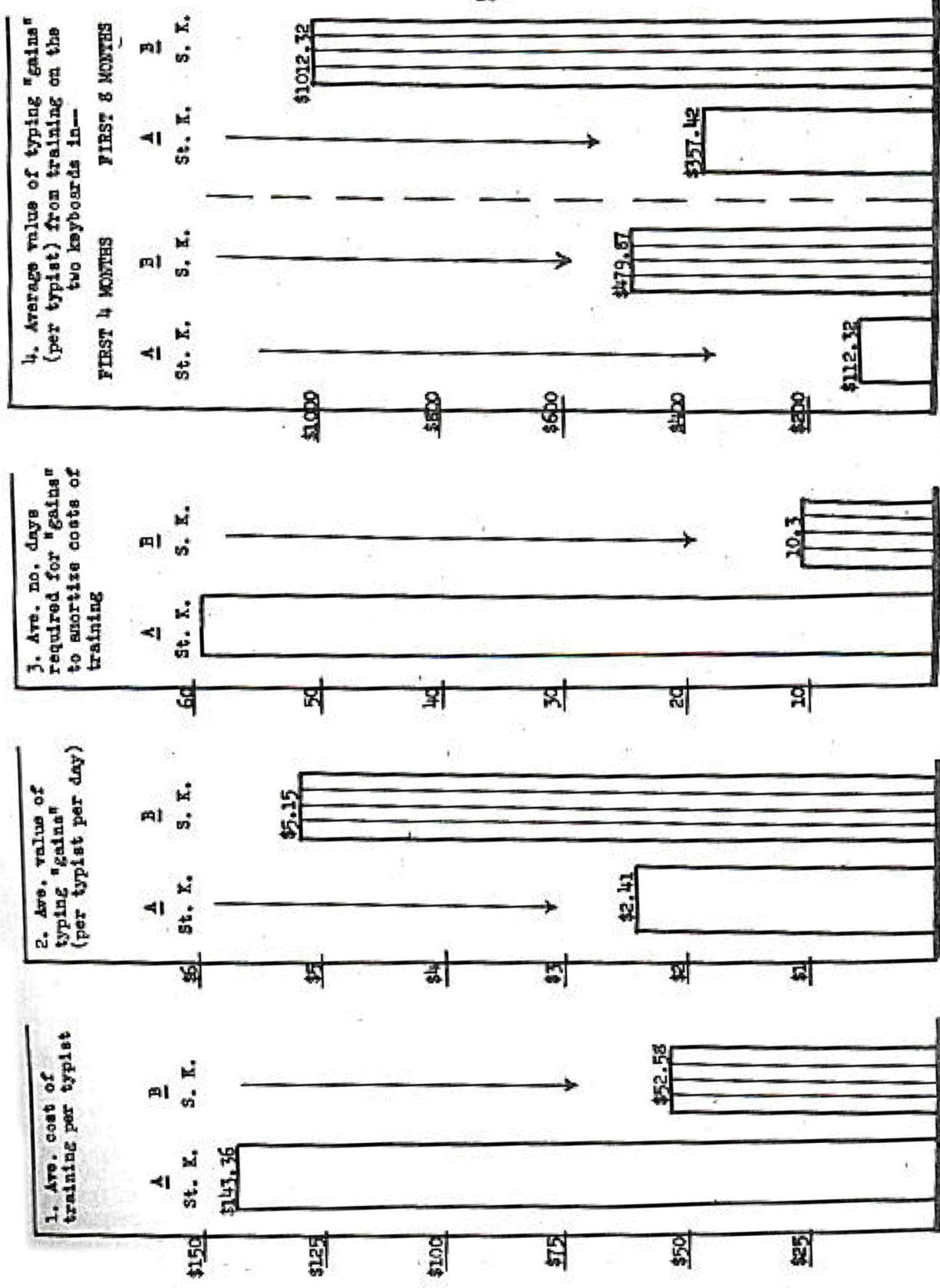


Figure 2. Graphic comparison of average cost of training, average value of typing "gains" (per typist per day), average number days required to amortize costs of training, and the average value of typing "gains" from (A) 157.5 hours of additional training given 18 Standard Keyboard typists on the Standard Keyboard (St. K.), and (B) 83 hours of retraining given 14 Standard Keyboard typists on the Simplified Keyboard (S. K.).



the corresponding figure after eight months employment for the 14 Simplified Keyboard typists who had 83 hours of Simplified Keyboard training was \$1,012.32 per typist.

Table III presents some vitally important comparisons between the results of additional training on the Standard Keyboard and the results of retraining Standard Keyboard typists on the Simplified Keyboard. For Simplified Keyboard typists these data are derived from the report to which this is a supplement. The Standard Keyboard data are detailed in Tables I and II of this supplement.

#### SUMMARY AND CONCLUSIONS

Data from the two groups of typists in this experiment, as well as conclusions from various surveys, disclose that at present the average Navy Department typist can not type at more than 30 net words per minute. Mathematically interpreted, that means that approximately 50% of all Navy Department typists can not type at 30 net words per minute. Of these 50% many can type at more than 30 gross words per minute but they make so many typographical errors that the conventional error penalty reduces their net speed to less than 30 n.w.p.m. Errors, however, require so much correction time that the conventional error penalty does not fully measure the loss of production caused by errors.

To increase the typing skill of many inadequately skilled typists whom the Navy Department has had to employ, two procedures have been followed. First, "continuation" or "refresher" training in typewriting has been given to thousands of the less skilled typists. This training has usually been of the traditional skill-developing type on the Standard Keyboard and of indoctrination and instruction in Navy Department stenographic procedures. The extent of the typing skill developed by such training has generally been over-estimated because of the "halo effect" of the improvement in procedures. The second and more limitedly followed procedure has been to retrain on the Simplified Keyboard typists in need of improving their typing skill. The improvement in typing skill on the Simplified Keyboard has far exceeded the improvements on the Standard Keyboard. Instruction in Navy Stenographic procedures is easily incorporated in the Simplified Keyboard retraining. The question at issue is whether the greater improvement in skill on the Simplified Keyboard is sufficiently great to warrant the exclusive use of the second procedure.

The study which was the basis of this supplementary report disclosed that 18 Standard Keyboard typists in an average of 157.6 hours of training improved their net typing speed by 8.1 n.w.p.m. (from 29.2 to 37.3 n.w.p.m.) at a rate of .062 n.w.p.m. per hour of training. By comparison the 14 Standard Keyboard typists who were retrained on the Simplified Keyboard in an average of 83 hours improved their net speed by 24.2 n.w.p.m. (from 32.9 to 57.1 n.w.p.m.) at a rate of .70 n.w.p.m. per hour of training. The Simplified Keyboard retrainees, in about half the training time (83 hours vs. 157.6 hours), for about one third the cost (\$52.58 vs. \$143.36), achieved three times the improvement in net typing speed (24.2 vs. 8.1 n.w.p.m.) when compared with the 18 Standard Keyboard typists who were given "continuation" or "refresher" training on the Standard Keyboard.

These two studies indicate that although the new skill on the Simplified Keyboard develops at .70/.062, or about eleven times as rapidly as does the improvement of skill on the Standard Keyboard, retrainees on the Simplified Keyboard to show an improvement of typing skill must first acquire a skill on the Simplified Keyboard equivalent to their Standard Keyboard skill. In the case of the 14 Simplified Keyboard retrainees, this required 32.9/.70, or 47 hours of training. On the same basis the 18 typists in the second group would have required 29.2/.70, or 42 hours of training on the Simplified Keyboard to reach their Standard Keyboard speed. Consequently, it should be assumed that up to 50 hours of training on the Simplified Keyboard would be required by the poorer 60% of Navy Department typists to reach their Standard Keyboard typing speed. To be efficient and profitable, retraining or conversion programs on the Simplified Keyboard should be planned to provide a minimum of 100



TABLE III - SOME COMPARISONS BETWEEN RESULTS SECURED FROM GIVING 18 STANDARD KEYBOARD TYPISTS AN AVERAGE OF 157.6 HOURS OF ADDITIONAL TRAINING ON THE STANDARD KEYBOARD, AND FROM GIVING 14 STANDARD KEYBOARD TYPISTS AN AVERAGE OF 83 HOURS OF TRAINING ON THE SIMPLIFIED KEYBOARD

	Standard Keyboard	Simplified Keyboard
1. Average number hours training by the two groups	157.6	83
2. Average "gain in n.w.p.m." on Standard Keyboard after average of 157.6 hours training	8.1	
3. Average "gain in n.w.p.m." on Simplified Keyboard after average of 83 hours training		24.2
4. Learning rate in "n.w.p.m. gain" per hour of training	.062	.70
5. Average "% gain in n.w.p.m."	43%	74%
6. Average per-typist cost of securing "% gain in n.w.p.m."	\$143.36	\$5258
7. Average value of "% gain in n.w.p.m." per typist per day	\$2.41	\$5.15
8. Average number working days required to amortize training cost necessary to secure "% gain in n.w.p.m."	59.5	10.3
9. Average projected value of increased production from "% gain in n.w.p.m." per typist in first four months' employment after training with cost of training deducted	\$112.22	\$479.87
10. Average projected value of increased production from "% gain in n.w.p.m." per typist in first eight months' employment after training with cost of training deducted	\$357.42	\$1,012.32



hours of training on the Simplified Keyboard.\*

Such a training program applied to the poorer 60% of Navy Department typists would, through the value of the increased typing proficiency, amortize the cost of the programs in about 10 days of full employment after the typists were retrained. By comparison, typists in the "continuation" or "refresher" typing classes require from 60 to 116 working days to amortize the cost of the training. Simplified Keyboard retraining is three times as valuable as is "refresher" training on the Standard Keyboard when the value of the increased typing production on the two keyboards is calculated in the subsequent first eight months employment (\$1,012.32 vs. \$357.42). In the first four months employment, because of the greater cost of Standard Keyboard "refresher" training, the ratio is 4:1 (\$479.87 vs. \$112.32) in favor of the Simplified Keyboard.

It would appear that, in due course, a decision relative to the advisability of offering "refresher" typist training on the Standard Keyboard or retraining on the Simplified Keyboard is imminent. A tenable program of retraining of the poorer 50% to 60% of the Navy Department typists could be accomplished rapidly and smoothly by training pilot individuals or groups from each large office or section in each Bureau and Division. These might well be the poorest typists in each office in order that the temporary loss of their production during the retraining period would cause a minimum of disruption. When retrained, these first Simplified Keyboard typists could, because of their greatly improved skill, temporarily release the next poorer typists for retraining, etc. When all Navy Department typists, regardless of keyboard used, were capable of typing at 70 to 75 n.w.p.m., the program could advisably be discontinued or continued on a much reduced basis. Since the Simplified Keyboard retraining program will amortize itself with each typist in money cost and in typing production within a few weeks, and thereafter will show 75% to 100% money and production dividends, and since the retraining meets with the hearty approval of the typists who through experience with the Simplified Keyboard have a valid basis for an opinion regarding it, there seem to be no insurmountable obstacles to its immediate initiation.

\* The record of the only Navy Department typist who had more than 100 hours retraining shows that superior typists can, on the Simplified Keyboard, significantly improve their production, and very interestingly confirms the findings and recommendations of the reports on the two groups of typists. After more than 15 years of employed typing experience, this male typist typed on the Standard Keyboard at 58 net words per minute (99 gross words per minute with 41 errors per 10-minute test). After 39 hours of self-directed retraining on the Simplified Keyboard, the typist started practical typing at 40 n.w.p.m. on work which had to be faultless. For those 39 hours this typist's rate of learning was 1.02 n.w.p.m. per hour of retraining. After 140 hours of retraining, he reached 103 net words per minute with an over-all relearning rate of .74 n.w.p.m. per hour of retraining, having improved 78% in net speed and 83% in accuracy (reduction of errors). After 200 hours of retraining he is typing at 120 net words per minute, having improved at an over-all rate of .60 n.w.p.m. per hour of retraining and having improved 104% in net speed and 89% in accuracy. His over-all daily production of usable typed pages has more than doubled.



# COMPARISON BETWEEN TYPING PROGRESS FROM RETRAINING ON THE SIMPLIFIED KEYBOARD AND FROM ADDITIONAL TRAINING ON THE STANDARD KEYBOARD IN TWO NAVY DEPARTMENT CLASSES\*

Average Training--Simplified Keyboard ----- 83 hours  
Standard Keyboard----- 157.6 hours

Average Learning Rate per Trng. Hr. -- Simplified Keyboard ----- .70 n. w. p. m.  
Standard Keyboard ----- .062 n. w. p. m.

Average Improvement after  
83 hrs. on Simplified Keyboard 157.6 hrs. on Standard Keyboard

in gross words per minute -----	28%	-----	16%
in accuracy -----	68%	-----	17%
in net words per minute -----	74%	-----	28%

===== { ----- } = Gross Words per Minute (g. w. p. m.)  
===== { ----- } = Net Words per Minute (n. w. p. m.)  
===== { ----- } = Number Errors per Ten-minute Test  
(Dotted lines are progress curves for 157.6 hours addtl. trng. on Standard Keyboard)  
\* Both groups previously had 400 + hrs. training on the Standard Keyboard.

